Institutionalizing Reliability and Maintainability (R&M) Engineering in the DoD: A Total Program Implementation Approach

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Purpose / Outline

PURPOSE

- **Provide overview of the R&M Implementation Strategy upon approval of Directive-Type Memorandum DTM 11-003, Reliability Analysis, Planning, Tracking, and Reporting, March 21, 2011**

OUTLINE

- **DTM 11-003 Overview**
- **DTM 11-003 Policy Implementation**
- **Guidance and Standardization Activities**
- **Human Capital**
- **Summary**

DTM 11-003 Overview

- **Engineering activities (The Acquisition Strategy (AS) to describe tasks and processes to be stated in the RFP)**
  - R&M Allocations, block diagrams and predictions
  - Failure definitions and scoring criteria
  - Failure Mode, Effects and Criticality Analysis (FMECA)
  - Built-in test and maintainability demonstrations
  - Reliability Growth testing at system/subsystem level
  - Failure Reporting, Analysis and Corrective Action System (FRACAS)
- **Preliminary RAM-C Report in support of Milestone (MS) A and updated for MS B & C**
  - Provides early (Pre-MS A) reliability, availability, maintainability and ownership cost feasibility assessments of alternative concepts
    - Includes early formulation of maintenance & support concepts
  - Provides an audit trail that documents and supports JCIDS thresholds
  - Ensures correct balance between the sustainment metrics (Availability-KPP, Materiel Reliability-KSA, and Ownership Cost-KSA)
  - Provides early risk reduction by ensuring requirements are realistic and correct
- **AS and SEP to specify how the JCIDS sustainment thresholds have been translated into R&M design requirements for use in contract specifications**

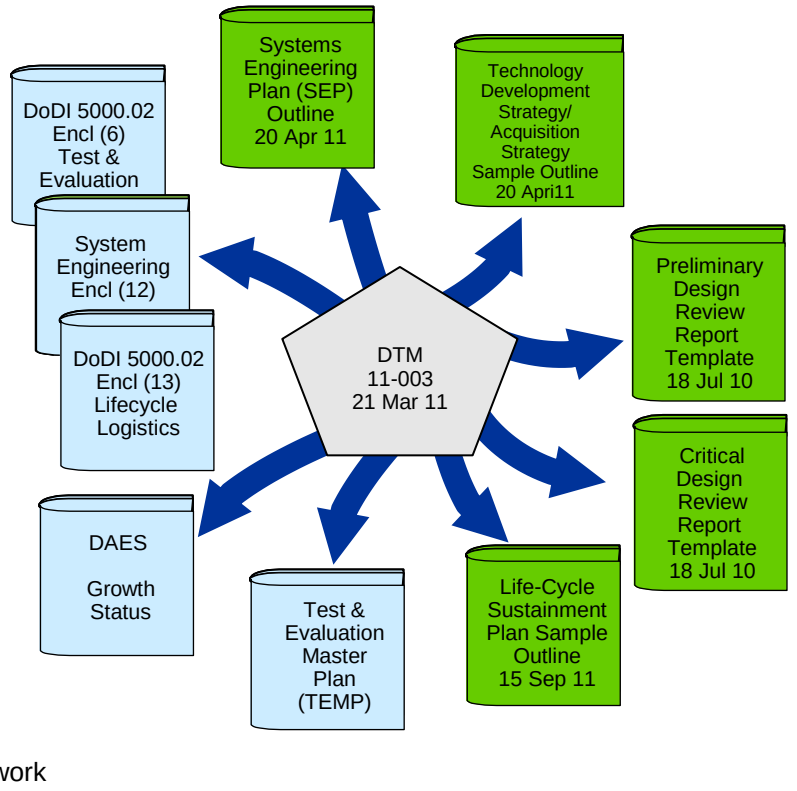
DTM 11-003 Overview

- **Reliability Growth Strategy**
  - Documents system-level reliability growth curves in the SEP beginning at MS A and updated in the Test & Evaluation Master Plan (TEMP) beginning at MS B
  - Establishes intermediate goals for reliability growth curves that will be tracked through fully integrated system-level test and evaluation events until the threshold is achieved
  - Requires MS C PMs and Operational Test Agencies to assess reliability growth required to achieve the reliability threshold during Initial Operational Test and Evaluation
- **Tracking and Monitoring**
  - Requires PMs to report status of reliability objectives and/or thresholds as part of the formal system engineering review process
  - Incorporates Reliability Growth Curves into the Defense Acquisition Executive System (DAES) review process

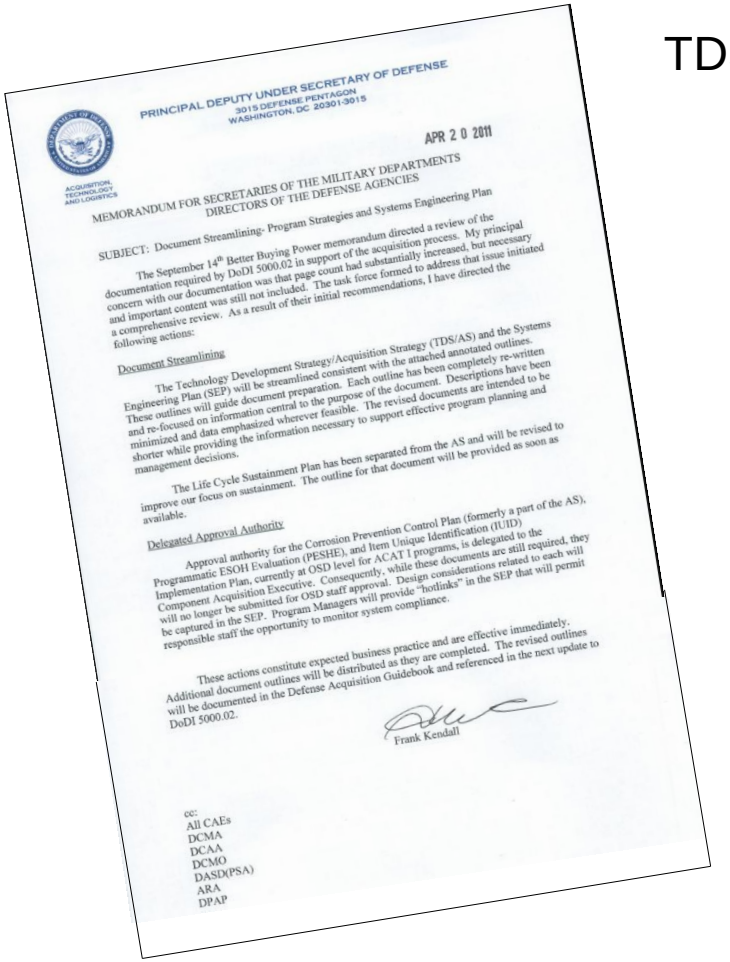
Policy Implementation DTM 11-003

- **Integrating DTM requirements in DoD Policy Documents**
  - DoDI 5000.02, Encl 13 (Logistics)
  - DoDI 5000.02, Encl 12 (SE)
  - DoDI 5000.02, Encl 6 (T&E)
  - Systems Engineering Plan Outline
  - Technology Development Strategy and Acquisition Strategy Outlines
  - Preliminary and Critical Design Review Report Template
  - Life Cycle Sustainment Plan Sample Outline
  - TEMP Outline
  - DAES Growth Status

DTM Relationship to DoD Policy and Acquisition Document



Annotated Outlines for TDS/AS, SEP Released as "Expected Business Practice"



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ACQUISITION, TECHNOLOGY AND LOGISTICS

APR 2 0 2011

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
DIRECTORS OF THE DEFENSE AGENCIES

SUBJECT: Document Streamlining- Program Strategies and Systems Engineering Plan

The September 14th Better Buying Power memorandum directed a review of the documentation required by DoDI 5000.02 in support of the acquisition process. My principal concern with our documentation was that page count had substantially increased, but necessary and important content was still not included. The task force formed to address that issue initiated a comprehensive review. As a result of their initial recommendations, I have directed the following actions:

Document Streamlining

The Technology Development Strategy/Acquisition Strategy (TDS/AS) and the Systems Engineering Plan (SEP) will be streamlined consistent with the attached annotated outlines. These outlines will guide document preparation. Each outline has been completely re-written and re-focused on information central to the purpose of the document. Descriptions have been minimized and data emphasized wherever feasible. The revised documents are intended to be shorter while providing the information necessary to support effective program planning and management decisions.

The Life Cycle Sustainment Plan has been separated from the AS and will be revised to improve our focus on sustainment. The outline for that document will be provided as soon as available.

Delegated Approval Authority

Approval authority for the Corrosion Prevention Control Plan (formerly a part of the AS), Programmatic ESOH Evaluation (PESHE), and Item Unique Identification (IUID) Implementation Plan, currently at OSD level for ACAT I programs, is delegated to the Component Acquisition Executive. Consequently, while these documents are still required, they will no longer be submitted for OSD staff approval. Design considerations related to each will be captured in the SEP. Program Managers will provide "hotlinks" in the SEP that will permit responsible staff the opportunity to monitor system compliance.

These actions constitute expected business practice and are effective immediately. Additional document outlines will be distributed as they are completed. The revised outlines will be documented in the Defense Acquisition Guidebook and referenced in the next update to DoDI 5000.02.

Frank Kendall

cc:
All CAEs
DCMA
DCAA
DCMO
DASD(PSA)
ARA
DPAP

TDS/AS and SEP outlines signed this year

Classification/Distribution Statement, as required

TECHNOLOGY DEVELOPMENT STRATEGY

[or]

ACQUISITION STRATEGY

FOR

[PROGRAM NAME]

[Sample Outline]

20 April 2011

Version 1.0, 04/20/2011

1

SYSTEMS ENGINEERING PLAN (SEP) OUTLINE

20 April 2011

Version 1.0, 04/20/2011

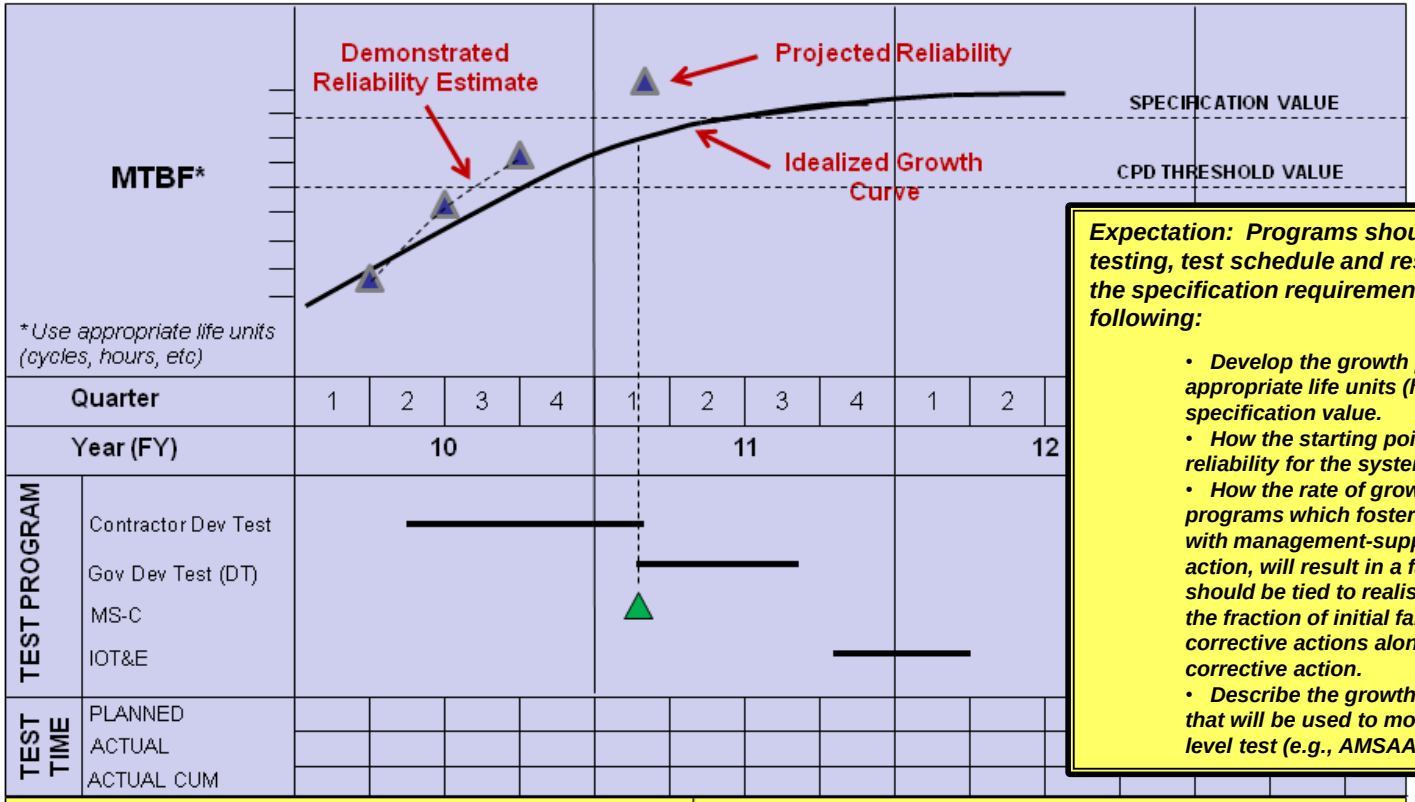
1

OPR: ODASD (Systems Engineering) SEP@osd.mil

http://www.acq.osd.mil/se/docs/PDUSD-ATLMemo-Expected-Bus-Practice-TDS_AS_SEP-20Apr11.pdf

Reliability Growth Reporting in the Systems Engineering Plan

Document the Reliability Growth Curve beginning at MS A, updated at each successive milestone, …



Expectation: Programs should understand the amount of testing, test schedule and resources available for achieving the specification requirement. Programs should consider the following:

- ***Develop the growth planning curve as a function of appropriate life units (hours, cycles, etc,) to grow to the specification value.***
- ***How the starting point that represents the initial value of reliability for the system was determined.***
- ***How the rate of growth was determined. Rigorous test programs which foster the discovery of failures, coupled with management-supported analysis and timely corrective action, will result in a faster growth rate. The rate of growth should be tied to realistic management metrics governing the fraction of initial failure rate to be addressed by corrective actions along with the effectiveness of the corrective action.***
- ***Describe the growth tracking and projection methodology that will be used to monitor reliability growth during system-level test (e.g., AMSAA-Crowe Extended, AMPM).***

System:

Date:

Remarks:

1. Demonstrated Reliability Estimate – Statistical estimate of reliability based on test data.
2. Projected Reliability – Assessment of reliability based on test data and engineering assessment of corrective action effectiveness.

Reliability Engineering Design and Test Activities

Describe planning and timing to generate R&M artifacts.

R&M Engineering Activity	Planning and Timing
R&M Allocations	
R&M Block Diagrams	
R&M Predictions	
Failure Definitions and Scoring Criteria	
Failure Mode, Effects, and Criticality Analysis (FMECA)	
Maintainability and Built-in Test Demonstrations	
Reliability Growth Testing at the System and Subsystem Level	
Failure Reporting , Analysis, and Corrective Action System (FRACAS)	

Table 4.6-2 R&M Activity Planning and Timing (mandated) (sample)

•Expectation: Programs should understand that the content of the R&M artifacts need to be consistent with the level of design knowledge that makes up each technical baseline.

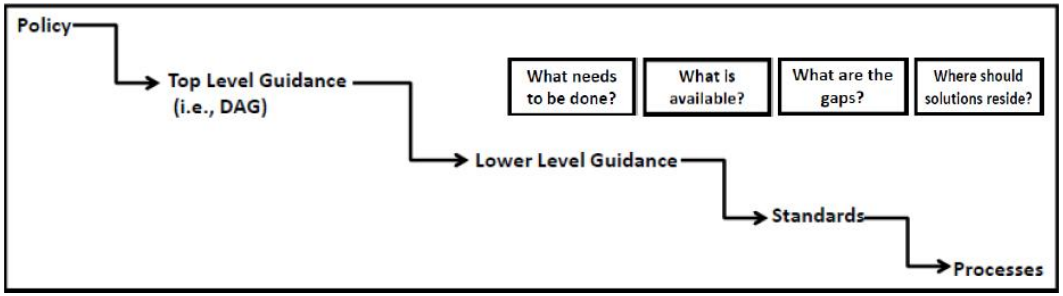
- ***R&M Allocations – R&M requirements assigned to individual items to attain desired system level performance. Preliminary allocations are expected by SFR with final allocations completed by PDR.***
- ***R&M Block Diagrams – The R&M block diagrams and math models prepared to reflect the equipment/system configuration. Preliminary block diagrams are expected by SFR with the final completed by PDR.***
- ***R&M Predictions – The R&M predictions provide an evaluation of the proposed design or for comparison of alternative designs. Preliminary predictions are expected by PDR with the final by CDR.***
- ***•Failure Definition and Scoring Criteria – Failure definitions and scoring criteria to make assessments of R&M contract requirements.***
- ***FMECA – Analyses performed to assess the severity of the effects of component/subsystem failures on system performance. Preliminary analyses are expected by PDR with the final by CDR.***
- ***Maintainability and Built-In Test – Assessment of the quantitative and qualitative maintainability and Built-In test characteristics of the design.***
- ***Reliability Growth Testing at the System and Subsystem Level – Reliability testing of development systems to identify failure modes, which if uncorrected could cause the equipment to exhibit unacceptable levels of reliability performance during operational usage.***
- ***FRACAS – Engineering activity during development, production, and sustainment to provide management visibility and control for R&M improvement of hardware and associated software by timely and disciplined***

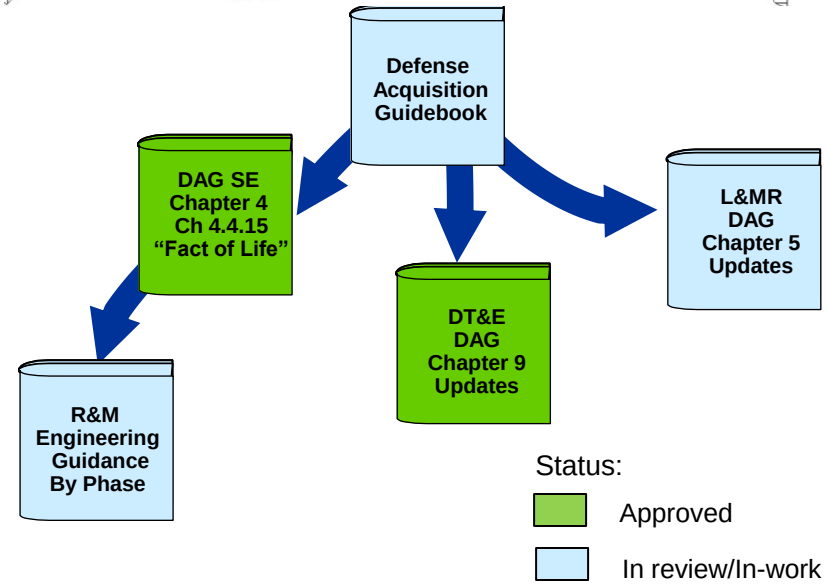
Guidance and Standardization Activity

- **Defense Acquisition Guidance**
  - Updated the Defense Acquisition Guidebook (DAG) Chapter 4, paragraph 4.4.15 for “fact of life” changes
  - Developing detailed R&M engineering guidance by phase and by program functional areas
  - Developing R&M contracting guidance that considers program type and phase to tailor requirements for cost-effective application
- **Integrating R&M guidance with DAG Editors**
- **R&M Standards working group**
  - Priority given to standards that directly relate to R&M engineering activities required by the DTM
  - Lower level Guidance developed with Service input will serve to determine standardization needs

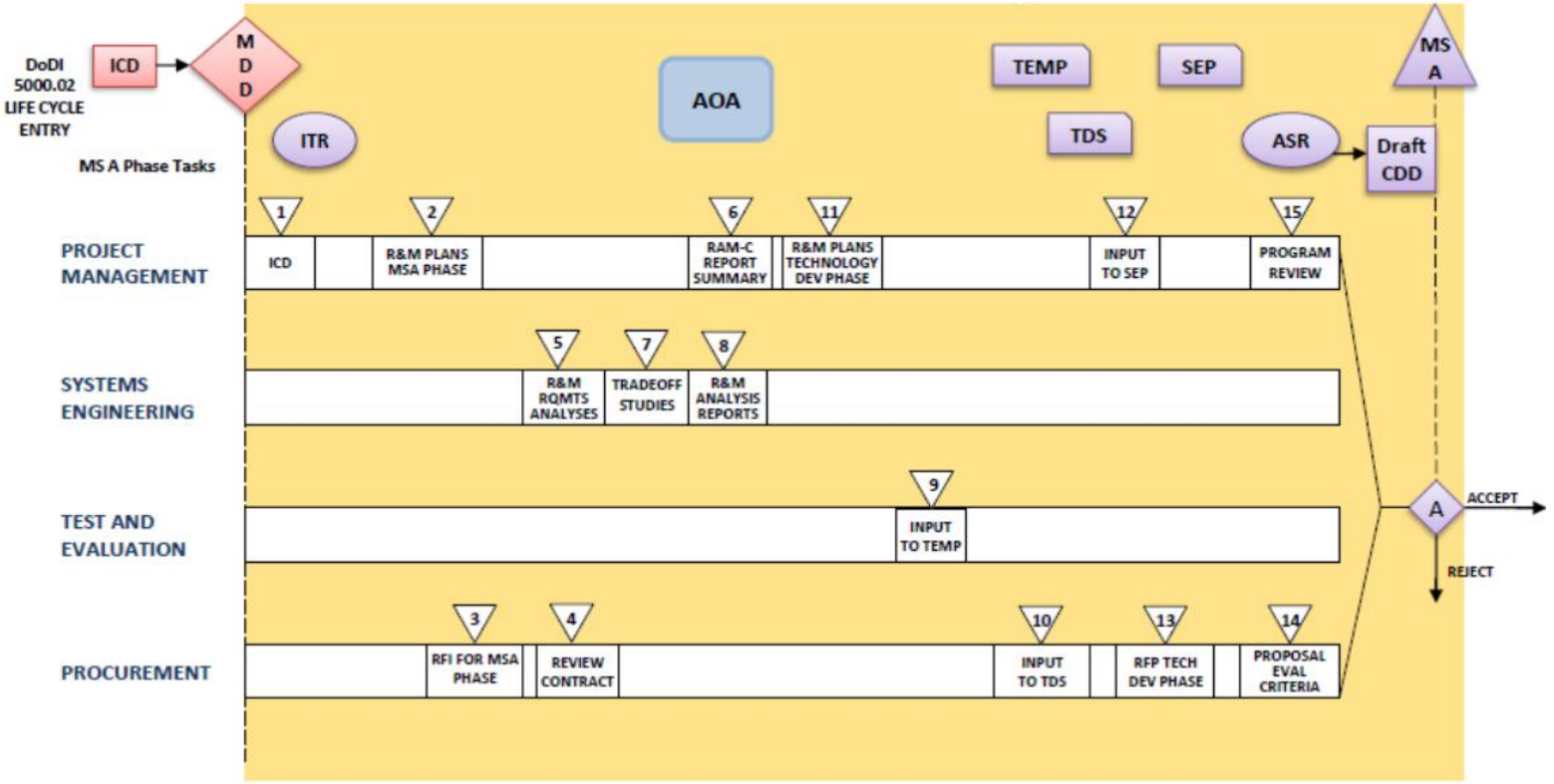
Table 1. DTM 11-003 Required R&M Engineering Activities by Functional Area

Functional Area	DTM 11-003-Required R&M Engineering Activities	MSA	TD	E&MD	P&D	O&S
Project Management	Formulate a comprehensive R&M program using appropriate reliability growth strategy	•	•	•	•	•
Project Management	Integrate R&M Engineering Program in Systems Engineering Plan (SEP) including a system reliability growth curve	•	•	•		
Project Management	Prepare/Update RAM-C Report and attach to the SEP	•	•	•		
Project Management	Report reliability status during formal design review process and technical reviews (SRR, PDR, CDR, etc.)	•	•	•		
Project Management	Prepare reliability growth assessment of the likelihood of meeting the CDD threshold by IOT&E			•		
Project Management	Evaluate reliability growth and report status in DAES reviews until the th[illegible]achieved			•		
[illegible]	[illegible]e allocation					





Materiel Solution Analysis Phase



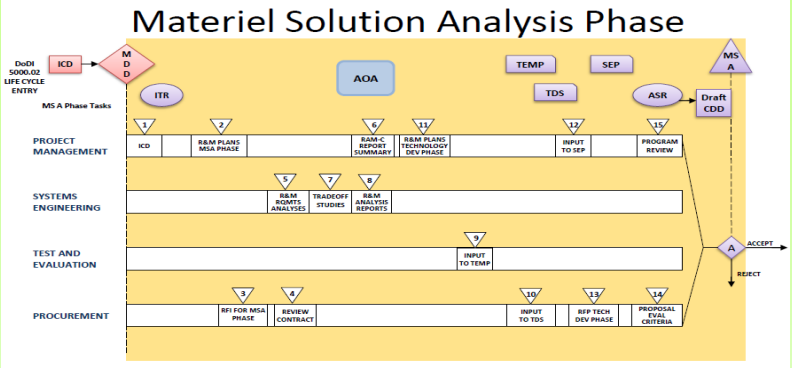
R&M Task	Paragraph
1 Review ICD for R&M objectives	1.1.1
2 Develop R&M plans for MSA Phase	1.1.2
3 Prepare R&M input into RFI for MSA Phase	1.4.1
4 Review MSA Phase contract	1.4.1
5 Perform R&M requirements analyses	1.2.1

R&M Task	Paragraph
6 Prepare RAM-C Report Summary	1.1.3
7 Perform design tradeoff studies	1.2.2
8 Prepare R&M analysis reports	1.2.3
9 Provide R&M input to TEMP	1.3.1
10 Prepare R&M input to TDS	1.4.2

R&M Task	Paragraph
11 Prepare R&M plans for TD Phase	1.1.4
12 Provide R&M input to SEP	1.1.5
13 Prepare R&M input to RFP for TD Phase	1.4.3
14 Prepare R&M criteria for proposal evaluation	1.4.4
15 Perform R&M program review	1.1.6

Human Capital

- **Objective: Increase PM demand for R&M Engineering and enhance R&M Engineering professional capabilities to successfully implement a R&M program.**
- **Approach**
  - Define R&M Engineering tasks
  - Develop R&M Engineering competencies for PM and R&M Engineers
  - Submit R&M competencies to DAU for curriculum development via SE FIPT chair
  - DAU develops training architecture, curriculums, training content and delivers training.



Capture/Define R&M Engineering Tasks and Associated Roles

Define R&M Engineering Competencies For Associated Roles (incl. KSAs)

Define R&M Engineering Learning Architecture (e.g. CLMs, SPRDE/SE Courses & R&M Competencies Integration, Dedicated R&M Courses)

Develop and Deliver Training

Summary

- **Actively engaged on all Focus Areas to improve "Technical Health" of R&M Engineering**
- **Institutionalizing the process across the Services**
- **Collaborating with other stakeholders (e.g., test, logistics …)**
- **DTM implementation will:**
  - Not burden the programs with unreasonable expectations
  - Not drive a "One Size Fit All Solution" on programs
    - Smartly apply engineering activities based on acquisition strategy and life cycle position

For Additional Information

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Acronyms

- AoA – Analyses of Alternatives
- AS – Acquisition Strategy
- ASR – Alternative Systems Review
- CDD – Capability Description Document
- DAES – Defense Acquisition Executive System
- DAG – Defense Acquisition Guide
- DAU – Defense Acquisition University
- DoD – Department of Defense
- DoDI – Department of Defense Instruction
- DT – Developmental Test
- DTM – Directive -Type Memorandum
- FIPT – Functional Integrated Process Team
- FMECA – Failure Mode, Effects and Criticality Analysis
- FRACAS – Failure Reporting, Analysis and Corrective Action System
- FY – Fiscal Year
- ICD – Initial Capabilities Document
- ITR – Initial Technical Review
- JCIDS – Joint Capabilities Integration and Development System
- KPP – Key Performance Parameters
- KSA – Key System Attribute
- MS – Milestone
- MSA – Materiel Solution Analysis
- MTBF – Mean Time Between Failure
- PM – Program Manager
- R&M – Reliability and Maintainability
- RAM-C – Reliability, Availability, Maintainability, and Cost Rationale
- RFP – Request for Proposal
- SE – Systems Engineering
- SEP – Systems Engineering Plan
- T&E – Test and Evaluation
- TDS – Technology Development Strategy
- TEMP – Test and Evaluation Master Plan